

Mr. Pond, the Astronomer-Royal, for the purpose of carrying out the views of the Council.

A long correspondence ensued, the result of which was, that Government "concurred in the proposed extension of the establishment at Greenwich;" and, moreover, gave the Council power to select the necessary officers. "From the beginning of Flamsteed's superintendence to the end of Maskelyne's, one assistant only was attached to the Observatory. During Pond's superintendence, the number was gradually increased to six. With these assistants the observations can be kept up without difficulty at all hours, which are necessary; but they are hardly sufficient for completing the mass of calculations which the observations require, and for carrying on the rating, as well as the business of other kinds connected with the Government chronometers⁵⁰." All the observations made under the superintendence of Mr. Pond were forwarded to the Royal Society, and published at the public expense by the Society. They form ten large folio volumes.

⁵⁰ Airy: article, Greenwich Observatory, *Penny Cyclopædia*. From 1796, when Harrison's improved watch, or chronometer, was first tried, to the present time, an immense number of chronometers of different constructions have undergone trials at the Royal Observatory. I have seen several dozens in the rating room, some surrounded by ice, others in high temperatures, to test their compensation principles.

Weld
History of
the Royal
Society

BAB BAGE

CHAPTER XI.

The Society receive a Letter from the Treasury respecting Mr. Babbage's Calculating Machine—Letter from Mr. Babbage to Sir H. Davy—A Committee appointed to consider Mr. Babbage's Plan—They Report in favour of it—Mr. Babbage has an interview with the Chancellor of the Exchequer—Government advance 1,500*l.*—Difference-Engine commenced—Mr. Babbage gives all his labour gratuitously—Advice of the Society again requested—Mr. Babbage's Statement—Committee appointed to inspect the Engine—Their Report—Heavy Expenses not met by the Treasury—Meeting of Mr. Babbage's personal friends—Their Report—Duke of Wellington inspects the Works—His Grace recommends the Treasury to make further Payments—Letter from Mr. Babbage to the Treasury—Communication from the Treasury to the Council—Referred to a Committee—Report of Committee—They recommend the Works to be removed to the vicinity of Mr. Babbage's Residence—Government act on the Recommendation—Fire-Proof Buildings erected—Misunderstanding with Mr. Clement—Works stopped—Mr. Babbage discovers new principles which supersede those connected with the Difference-Engine—He requests an interview with Lord Melbourne—Letter to M. Quetelet explaining the principles of Analytical-Engine—Mr. Babbage visits Turin—M. Menabrea's Account of the Engine—Translated with Notes by Lady Lovelace—Mr. Babbage applies to Government for their Determination—Letter from the Chancellor of the Exchequer—Mr. Babbage's Answer—Government resolve not to proceed with the Engine—Mr. Babbage has an interview with Sir R. Peel—Difference-Engine placed in the Museum of King's College—Present State of the Analytical-Engine.

1820—25.

ON the 1st April, 1823, a letter was received from the Treasury, requesting the Council to take into consideration a plan which had been submitted to Government by Mr. Babbage, for "applying ma-

chinery to the purposes of calculating and printing mathematical tables;" and the Lords of the Treasury further desired "to be favoured with the opinion of the Royal Society on the merits and utility of this invention¹."

This is the earliest allusion to the celebrated Calculating Engine of Mr. Babbage, in the records of the Society². But the invention had been brought before them in the previous year by a letter from Mr. Babbage to Sir H. Davy, dated July 3rd, 1822, in which he gives some account of a small model of his engine for calculating differences, which "produced figures at the rate of 44 a minute, and performed with rapidity and precision all those calculations for which it

¹ In the following account of the Difference and Analytical Engines, besides the MS. documents in the Archives of the Royal Society, I have derived very valuable information from an unpublished statement drawn up by Mr. Babbage, which he has been so kind as to place in my hands. The original documents which are in Mr. Babbage's possession, and which are referred to, I have myself examined.

² The idea of a Calculating Engine is not new. The celebrated Pascal constructed a machine for executing the ordinary operations of arithmetic, a description of which will be found in the *Encycl. Méthod.*, and in the Works of Pascal, Tom. iv. p. 7, Paris 1819. In his *Pensées* he says, alluding to this Engine: "*La machine arithmétique fait des effets qui approchent plus de la pensée que tout ce que font les animaux; mais elle ne fait rien qui puisse faire dire qu'elle a de la volonté comme les animaux.*" Subsequently, Leibnitz invented a machine by which, says Mr. De Morgan, "arithmetic computations could be made." Polenus, a learned and ingenious Italian, invented a machine by which multiplication was performed—and mechanical contrivances for performing particular arithmetical processes were made about a century ago, but they were merely modifications of Pascal's. These Engines were very different to Mr. Babbage's Difference-Engine.

was designed³." He then proceeds to enumerate various tables which the machine was adapted to calculate, and concludes: "I am aware that these statements may perhaps be viewed as something more than Utopian, and that the philosophers of Laputa may be called up to dispute my claim to originality. Should such be the case, I hope the resemblance will be found to adhere to the nature of the subject, rather than to the manner in which it has been treated. Conscious from my own experience of the difficulty of convincing those who are but little skilled in mathematical knowledge, of the possibility of making a machine which shall perform calculations, I was naturally anxious, in introducing it to the public, to appeal to the testimony of one so distinguished in the records of British science⁴. Induced by a conviction of the great utility of such engines, to withdraw for some time my attention from a subject on which it has been engaged during several years, and which possesses charms of a higher order, I have now arrived at a point where success is no longer doubtful. It must, however, be attained at a very considerable expense, which would not probably be replaced by the works it might produce for a long period of time, and which is an undertaking I should feel unwilling to commence, as altogether foreign to my habits and pursuits."

The Council appointed a Committee to take Mr. Babbage's plan into consideration, which was composed of the following gentlemen: Sir H. Davy, Mr.

³ This letter was printed and published in July, 1822.

⁴ Sir H. Davy had witnessed and expressed his admiration of the performances of the Engine.

Brande, Mr. Combe, Mr. Baily, Mr. (now Sir Mark Isambard) Brunel, Major (now General) Colby, Mr. Davies Gilbert, Mr. (now Sir John) Herschel, Captain Kater, Mr. Pond (Astronomer-Royal), Dr. Wollaston, and Dr. Young. On the 1st May, 1823, the Committee reported: "That it appears that Mr. Babbage has displayed great talents and ingenuity in the construction of his machine for computation, which the Committee think fully adequate to the attainment of the objects proposed by the inventor, and that they consider Mr. Babbage as highly deserving of public encouragement in the prosecution of his arduous undertaking."

This Report was transmitted to the Lords of the Treasury, by whom it was, with Mr. Babbage's letter to Sir H. Davy, printed and laid before Parliament⁶.

In July, 1823, Mr. Babbage had an interview with the Chancellor of the Exchequer, Mr. Robinson (now Earl of Ripon), to ascertain if it were the wish of Government that he should construct a large engine of the kind, which would also print the results it calculated. Unfortunately, no Minute of that conversation was made at the time, nor was any sufficiently distinct understanding arrived at, as it afterwards appeared that a contrary impression was left on the mind of either party⁷. Mr. Babbage's con-

⁶ I am informed upon good authority, that Dr. Young differed in opinion from his colleagues. Without doubting that an engine could be made, he conceived that it would be far more useful to invest the probable cost of constructing such a calculating machine as was proposed, in the funds, and apply the dividends to paying calculators.

⁷ Parliamentary Paper, No. 370, 1823.

⁸ Mr. Babbage very justly observes, that had the mutual re-

viction was, that whatever might be the labour and difficulty of the undertaking, the engine itself would, of course, become the property of the Government, which had paid for its construction.

Soon after this interview with the Chancellor of the Exchequer, a letter was sent from the Treasury to the Royal Society, informing them that the Lords of the Treasury "had directed the issue of 1500*l.* to Mr. Babbage, to enable him to bring his invention to perfection, in the manner recommended."

These words "*in the manner recommended*," can refer only to the previous recommendation by the Royal Society; but it does not appear from their Report, that any plan, terms, or conditions, had been pointed out.

Towards the end of July, 1823, Mr. Babbage took measures for the construction of the present Difference-Engine⁸, and it was regularly proceeded with for four years.

And here it is right to state, that Mr. Babbage gave his mental labour gratuitously, and that from first to last he has not derived any emolument whatever from Government⁹. Sectional, and other drawings, of the most delicate nature had to be made;

lations of the two parties, and the details of the plans then adopted, been clearly defined, there is little doubt but that the Difference-Engine would long since have existed.

⁸ It will be desirable to distinguish between,

1. The small *Model* of the Original or Difference-Engine.
2. The Difference-Engine itself, belonging to the Government, a part only of which has been put together.
3. The designs for another Engine called the Analytical-Engine.

⁹ Sir R. Peel distinctly admitted this in the House of Commons in March, 1843.

tools to be formed expressly to meet mechanical difficulties; and workmen to be educated in the practical knowledge necessary in the construction of the machine. The mechanical department was placed under the management of Mr. Clement, a draughtsman of great ability, and a practical mechanic of the highest order¹⁰. Money was advanced from time to time by the Treasury, the accounts furnished by the engineer undergoing the examination of auditors¹¹, and passing through the hands of Mr. Babbage. Thus years elapsed, and public attention became at length directed to the fact, that a large sum had been expended upon the construction of the engine, which was not completed. Again the advice of the Royal Society was solicited.

In December, 1828, Government begged the Council "to institute such enquiries as would enable them to report upon the state to which it (the machine) had then arrived; and also whether the progress made in its construction confirmed them in the opinion which they had formerly expressed, that it would ultimately prove adequate to the important object which it was intended to attain."

Accompanying this communication was a state-

¹⁰ A curious anecdote is related illustrative of the great perfection to which Mr. Clement was in the habit of bringing machinery. He received an order from America to construct a large screw in the *best possible manner*, and he accordingly made one with the greatest mathematical accuracy. But his bill amounted to some hundreds of pounds which completely staggered the American, who never calculated upon paying more than 20*l.* at the utmost for the screw. The matter was referred to arbitrators, who gave an opinion in favour of Mr. Clement.

¹¹ They were Messrs. Brunel, Donkin, and Field.

ment from Mr. Babbage of the condition of the engine, in which he says:—

"The machine has required a longer time and greater expense than was anticipated, and Mr. Babbage has already expended about 6000*l.* on this object. The work is now in a state of considerable forwardness, numerous and large drawings of it have been made, and much of the mechanism has been executed, and many workmen are occupied daily in its completion."

A Committee was appointed by the Council, consisting of Mr. Gilbert (President), Dr. Roget, Captain Sabine, Sir John Herschel, Mr. Baily, Mr. Brunel, Captain Kater, Mr. Donkin, Mr. Penn, Mr. Rennie, Mr. Barton, and Mr. Warburton¹².

They minutely inspected the drawings, tools, and the parts of the engine then executed, and drew up a report, "declining to consider the principle on which the practicability of the machinery depends, and of the public utility of the object which it proposes to attain; because they considered the former fully admitted, and the latter obvious to all who consider the immense advantage of accurate numerical tables in all matters of calculation, which it is professedly the object of the engine to calculate and print with perfect accuracy."

They further stated, that "the progress made was as great as could be expected, considering the numerous difficulties to be overcome; and lastly, that they had no hesitation in giving it as their opinion, that the engine was likely to fulfil the expectations entertained of it by its inventor."

¹² Colonel Sabine informs me, that Dr. Whewell was afterwards added to the Committee.

The Council adopted the Report, expressing their trust, that while Mr. Babbage's mind was intently occupied on an undertaking likely to do so much honour to his country, he might be relieved as much as possible from all other sources of anxiety.

It is clear that the Council of the Royal Society regarded Mr. Babbage's engine, as it then existed, in a favourable light, and were sanguine respecting its satisfactory completion.

Government acted on the foregoing Report; funds were advanced, the machinery was declared national property, and the works were continued. But there was evidently a misgiving on the part of the Lords of the Treasury, for the official payments soon failed to meet the heavy and increasing expenses incurred by Mr. Babbage.

Under these circumstances, by the advice of Mr. Wolryche Whitmore (Mr. Babbage's brother-in-law), a meeting of Mr. Babbage's personal friends was held on the 12th of May, 1829. It consisted of:—

The Duke of Somerset, F.R.S.,
 Lord Ashley, M.P.,
 Sir John Franklin, Capt. R.N., F.R.S.,
 Mr. Wolryche Whitmore, M.P.,
 Dr. Fitton, F.R.S.,
 Mr. Francis Baily, F.R.S.,
 Sir John Herschel, F.R.S.

They drew up the annexed Report:—

"May 12, 1829.

"THE attention of the undersigned personal friends of Mr. Babbage having been called by him to the actual state of his Machine for Calculating and Printing Mathematical Tables; and to his relation to the Government on the one hand, and to the Engineers and

workmen employed by him in its execution on the other, declare themselves satisfied, from his statements and from the documents they have perused, of the following facts.

"That Mr. Babbage was originally induced to take up the work on its present extensive scale, by an understanding on his part, that it was the wish of Government that he should do so, and by an advance of 1500*l.* in the outset, with a full impression on his mind that such further advances would be made as the progress of the work should require, and as should secure him from ultimate loss.

"That the public and scientific importance of the Engine has been acknowledged, in a Report of a Committee of the Royal Society, made at the time of its first receiving the sanction of His Majesty's Government, and that its actual state of progress is such, as in the opinion of the most eminent Engineers and other Members of the Royal Society, as detailed in a further Report of a Committee of that body, to warrant their impression of the moral certainty of its success, should funds not be wanting for its completion.

"That it appears, that Mr. Babbage's actual expenditure has amounted to nearly 7000*l.* and that the whole sum advanced to him by the Government is 3000*l.*

"That Mr. Babbage has devoted, from the commencement of his arduous undertaking, the most assiduous and anxious attention to the work in hand, to the injury of his health, and the neglect and refusal of other profitable occupations.

"That a very large expense still remains to be incurred, to the probable amount of at least 4000*l.*, as far as he can foresee, before the Engine can be completed; but that Mr. Babbage's private fortune is not such as,

in their opinion, to justify the sacrifices he must make in completing it without further and effectual assistance from Government; taking into consideration not only his own interest, but that of his family dependent on him.

"Under these circumstances, it is their opinion that a full and speedy representation of the case ought to be made to Government, and that in the most direct manner by a personal application to his Grace the Duke of Wellington.

"And that in case of such application proving unsuccessful in procuring effectual and adequate assistance, they must regard Mr. Babbage as no longer called on—considering the pecuniary and personal sacrifices he will then have made; considering the entire and *bond fide* expenditure of all that he will have received from the public purse on the object of its destination, and considering the moral certainty to which it is at length by his exertions reduced—as no longer called on to go on with an undertaking which may prove the destruction of his health, and the great injury if not the ruin of his fortune.

"That it is their opinion that Mr. W. Whitmore and Mr. Herschel should request an interview with the Duke of Wellington for the purpose of making this representation.

(Signed,)

"SOMERSET.

"ASHLEY.

"JOHN FRANKLIN.

"W. W. WHITMORE.

"WM. HENRY FITTON.

"FRANCIS BAILY.

"J. F. W. HERSCHEL."

In consequence of what passed at this interview, which took place as suggested, the Duke of Wellington, accompanied by the Chancellor of the Exchequer

(Mr. Goulburn) and Lord Ashley, inspected the *model* of the engine, the drawings, and parts in progress. The Duke recommended that a grant of 3000*l.* should be made towards the completion of the machine, which was duly paid by the Treasury.

In the mean time, difficulties of another kind arose. The engineer who had constructed the Engine under Mr. Babbage's directions, had delivered his bills in such a state, that it was impossible to judge how far the charges were just and reasonable; and although Mr. Babbage had paid several thousand pounds, there yet remained a considerable balance, which could not be liquidated until the accounts had been examined, and the charges approved by professional engineers.

With a view of drawing attention to these charges, Mr. Babbage addressed the following letter to the Chancellor of the Exchequer:—

"MY LORD, "Dorset Street, 21 December, 1830.

"I BEG to call your Lordship's attention to the enclosed account¹³ of the expenses of the Machine for calculating and printing mathematical tables, by which it appears that a sum of 592*l.* 4*s.* 8*d.* remained

	£.	s.	d.
¹³ Expense to end of 1824	600	0	0
Ditto " " 1827	531	16	9
Mr. Clement's Bills to June, 1827.....	4775	15	3
Ditto, 9th May, 1829	730	12	8
	6638	4	8
Deduct old tools sold	36	0	0
	6592	4	8
Mr. Clement's Bill to December, 1830, about..	600	0	0
	7192	4	8

due to myself upon the last account, and that a further sum of nearly 600*l.* has since become due to Mr. Clement.

"It is for the payment of this latter sum that I wish to call your Lordship's attention. Mr. Maudslay, one of the engineers appointed by the Government to examine the bills of Mr. Clement, having been unable from illness to attend, his report has been delayed, and Mr. Clement informs me that should the money remain unpaid much longer, he shall be obliged, from want of funds, to discharge some of the workmen; an event which I need not inform your Lordship would be very prejudicial to the progress of the machine.

"Another point which I wish to submit to your attention, when your Lordship shall have had leisure to examine personally the present state of the works, is, that since it is absolutely necessary to find additional room for the erection of the machine, it becomes a matter of serious consideration whether it would not contribute to the speedier completion of the machine, and also to economy in expenditure, to remove the works to the neighbourhood of my own residence.

"I have, &c.

"C. BABPAGE."

The receipt of this letter caused the Treasury to make the following communication to the Secretary of the Royal Society:—

"SIR, *Treasury, 24 December, 1830.*

"THE Lords Commissioners of H. M. Treasury, having had under their consideration a letter from Mr. Babbage, containing an account of the expense which has been incurred in the construction of the Machine for calculating and printing mathematical tables, amounting to the sum of 7192*l.* 4*s.* 8*d.*, and

requesting an advance of 600*l.* to defray a part of that expense; I am commanded by their Lordships to refer you to the Report of the Council of the Royal Society dated 16th February, 1829, which entirely satisfied their Lordships of the propriety of supporting Mr. Babbage in the construction of this machine, and to state that advances to the amount of 6000*l.* have been made on this account, and that directions have been given for a further advance of 600*l.*

"I am also to acquaint you, that the Machine is the property of Government, and consequently my Lords propose to defray the further expense necessary for its completion. I am further to request you will move the Council of the Royal Society to cause the machine to be inspected, and to favor my Lords with their opinion whether the work is proceeding in a satisfactory manner, and without unnecessary expense, and what further sum may probably be necessary for completing it.

"I am, &c.

"*The Secretary, Royal Society.*"

"J. STEWART.

The consideration of this letter was referred to the same Committee which had previously been appointed for a similar purpose, with the addition of Sir John Lubbock and Mr. Troughton.

Again the Committee met¹⁴ Mr. Babbage, at No. 21, Prospect Place, Lambeth (where the construction of the engine was carried on), and minutely inspected the machinery and drawings.

¹⁴ I have a letter of Sir J. Herschel's before me, expressing his regret at being unable to attend on this occasion, but that his faith in the engine and its inventor remained unshaken.

Their Report embodied the whole facts of the case:—the workmanship of the various parts of the machine was declared to have been executed with the greatest possible degree of perfection, and the pains taken to verify the charges on the part of the Government altogether satisfactory. It was recommended that the vacancy occasioned by the decease of Mr. Maudslay, who had been appointed to inspect the accounts, should be filled up by another engineer, conversant with the execution of machinery, and the value thereof. With respect to the suggested removal of the workshops nearer to Mr. Babbage's residence, the Committee gave their entire concurrence, on the ground that greater expedition would thereby be attained in carrying on the work, and that it was highly essential to secure all the machinery and drawings in fire-proof premises, without delay. A plot of ground held on lease by Mr. Babbage, adjacent to his garden at the back of his house in Dorset Street, was recommended as a desirable site for the contemplated erections, of which the plans and estimates had been submitted to the Committee. The framers of the Report stated in conclusion that:—

"Such an arrangement would be eminently conducive to the speedy and economical completion of the Machine, as well as to the effectual working and employment of the same, after it shall have been completed.

"That as to the sum which may be necessary for completing the Engine, they attach hereto the estimate of Mr. Brunel¹⁵."

¹⁵ Mr. Brunel's estimate appears in the following letter to Mr. Warburton:—

The Report, with Mr. Brunel's estimate, were sent to the Treasury on the 13th April, 1831: and having been approved by a Committee of practical engineers appointed by Government, the latter acted on the recommendations which it contained. The piece of ground adjoining Mr. Babbage's garden was taken, and a fire-proof building erected, designed to contain the plans and drawings, and also the engine when completed. But new and unforeseen difficulties arose. When about 17,000*l.* had been expended, further progress was arrested on account of a misunderstanding with Mr. Clement, who made the most extravagant demands as compensation for carrying on the construction of the engine in the new buildings. These demands could not be satisfied with proper regard to the justice due to Government. Mr. Clement accordingly withdrew from the undertaking, and carried with him all the valuable tools that had been used in the work; a proceeding the more unfortunate, as many of them had been in-

"DEAR SIR,

Feb. 23, 1831.

"HAVING taken into consideration the erection of the proposed shops, the removal of the machinery, the accommodation for it, and also for the maker; having also taken into consideration the further completion of the drawings, and the ultimate accomplishment of the Engine until it is capable of producing plates for printing; though I feel confident that the sum of 8000*l.* will be ample to realize the objects that are contemplated, I should nevertheless recommend that the Government be advised to provide for the sum of 12,000*l.* by way of estimate, and that the yearly sum required, exclusive of the sum requisite for the buildings and removal (say 2000*l.*), will not exceed from 2000*l.* to 2500*l.*

"I am, &c.

"Henry Warburton, Esq."

"M. I. BRUNEL.

vented expressly to meet the unusual forms and combinations arising out of the novel construction¹⁶.

An offer was made to surrender the tools, for a given sum, which was declined, and the works came to a stand-still. But other circumstances interposed to prevent the completion of the original design.

During the suspension of the works, Mr. Babbage had been deprived of the use of his own drawings. Having in the meanwhile naturally speculated upon the general principles on which machinery for calculation might be constructed, a *principle of an entirely new kind* occurred to him, the power of which over the most complicated arithmetical operations seemed nearly unbounded. This was the executing of analytical operations by means of an analytical-engine. On re-examining his drawings, when returned to him by the engineer, the new principle appeared to be limited only by the extent of the mechanism it might require. The invention of simpler mechanical means for performing the elementary operations of the engine, now derived a far greater importance than it had hitherto possessed; and should such simplifications be discovered, it seemed difficult to anticipate, or even to over-estimate, the vast results which might be attained.

These new views acquired additional importance from their bearings upon the engine already partly executed for the Government; for, if such simplifi-

¹⁶ This Mr. Clement had a legal right to do. Startling as it may appear to the unprofessional reader, it is nevertheless the fact, that engineers and mechanics possess the right of property to all tools that they have constructed, although the cost of construction has been defrayed by their employers.

cations should be discovered, it might happen that the Analytical-Engine would execute with greater rapidity the calculations for which the Difference-Engine was intended; or that the Difference-Engine would itself be superseded by a far simpler mode of construction.

Though these views might perhaps at that period have appeared visionary, they have subsequently been completely realized. To have allowed the construction of the Difference-Engine to be resumed, while these new conceptions were withheld from the Government, would have been improper; yet the state of uncertainty in which those views were then necessarily involved, rendered any written communication respecting their probable bearing on that engine, a task of very great difficulty. It therefore appeared to Mr. Babbage, that the most straightforward course was to ask for an interview with the head of the Government, and to communicate to him the exact state of the case.

On the 26th September, 1834, Mr. Babbage requested an audience of Lord Melbourne, for the purpose of placing these views before him; his Lordship acceded to the request, but from some cause the interview was postponed; and soon after, the ministry went out of office, without the desired conference having taken place.

The duration of the Duke of Wellington's administration was short; and no decision on the subject of the *Difference-Engine* was obtained.

In May, 1835, Mr. Babbage announced in a letter¹⁷

¹⁷ Mr. Babbage informs me, that this letter was intended only as a private communication.

to M. Quetelet, which was laid before the Academy of Sciences at Brussels, that he had "for six months been engaged in making the drawings of a new calculating engine of *far greater power than the first*." "I am myself astonished," says Mr. Babbage, "at the power I have been enabled to give to this machine; a year ago I should not have believed this result possible. This machine is intended to contain a hundred variables, or numbers susceptible of changing, and each of these numbers may consist of twenty-five figures. The greatest difficulties of the invention have already been surmounted, and the plans will be finished in a few months."

Subsequently to the date of this letter, Mr. Babbage visited Turin, where he explained to Baron Plana, M. Menabrea, and several other distinguished philosophers of that city, the mathematical principles of his Analytical-Engine, and also the drawings and engravings of the more curious mechanical contrivances, by which those principles were to be carried into effect. M. Menabrea, with Mr. Babbage's consent, published the information which he had received in the 41st volume of the *Bibliothèque Universelle de Genève*. The article is remarkable as giving the first account of the Analytical-Engine¹⁸. An English translation, with copious original notes, made by a

¹⁸ In the *Ninth Bridgewater Treatise*, Mr. Babbage has employed various arguments deduced from the Analytical-Engine, which afford some idea of its powers. See second edition. In 1838, several copies of plans of this new engine, engraved on wood, were circulated amongst Mr. Babbage's friends at the Meeting of the British Association at Newcastle.

In 1840, Mr. Babbage had one of his general plans of the Analytical-Engine lithographed at Paris.

lady of distinguished rank and talent¹⁹, was published in the third volume of Taylor's *Scientific Memoirs*.

But it did not contain all the information respecting the Difference-Engine that was desirable, and Mr. Babbage was consequently led to communicate a short article upon this subject to the *Philosophical Magazine*, which is inserted in the 23rd volume²⁰. The more comprehensive statements and official documents which Mr. Babbage has placed at my disposal renders it unnecessary to do more than allude to that article.

For nine years, that is, from the year 1833, when the construction of the Difference-Engine was suspended, until 1842, no decision respecting the machine was arrived at, although Mr. Babbage made several applications to Government on the subject.

On the 21st October, 1838, he wrote to the Chancellor of the Exchequer, stating that the question he

¹⁹ I am authorized by Lord Lovelace to say, that the translator is Lady Lovelace.

²⁰ "The Difference-Engine could only tabulate, and was incapable by its nature of developing; the Analytical-Engine was intended to either tabulate or develop." The Difference-Engine is the embodying of one particular and very limited set of operations, the Analytical-Engine, the embodying of the science of operations. The distinctive characteristic of the Analytical-Engine, is the introduction into it of the principle which Jacquard devised for regulating by means of punched-cards the most complicated patterns in the fabrication of brocaded stuffs. Nothing of the sort exists in the Difference-Engine. We may say most aptly, that the Analytical-Engine weaves *Algebraical patterns*, just as the Jacquard loom weaves flowers and leaves!"—Note to translation of Menabrea's Memoir. The 59th volume of the *Edinburgh Review* contains an able and elaborate article upon the Difference-Engine, written by Dr. Lardner.

wished to have settled was:—"Whether the Government required him to superintend the completion of the Difference-Engine, which had been suspended during the last five years, according to the original plan and principle, or whether they intended to discontinue it altogether." This letter produced no result. Time wore on, and Sir Robert Peel became Prime Minister. This was in 1841. Up to the termination of the Parliamentary Session in 1842, Mr. Babbage had received no other communication on the subject than a note from Sir George Clerk (Secretary to the Treasury), written in January of that year, stating that he feared the pressing official duties of Sir Robert Peel would prevent him turning his attention to the matter for some days.

Having availed himself of several private channels for recalling the question to Sir Robert Peel's attention without effect, Mr. Babbage, on the 8th of October, 1842, again wrote to him, requesting an early decision.

At last Mr. Babbage received the following letter:—

"MY DEAR SIR, *Downing Street, Nov. 3, 1842.*

"THE Solicitor-General has informed me that you are most anxious to have an early and decided answer as to the determination of the Government with respect to the completion of your Calculating Engine. I accordingly took the earliest opportunity of communicating with Sir R. Peel on the subject.

"We both regret the necessity of abandoning the completion of a Machine on which so much scientific ingenuity and labour have been bestowed. But on the other hand, the expense which would be necessary in order to render it either satisfactory to yourself, or generally useful, appears on the lowest calculation so

far to exceed what we should be justified in incurring, that we consider ourselves as having no other alternative.

"We trust that by withdrawing all claim on the part of the Government to the Machine as at present constructed, and by placing it at your entire disposal, we may, to a degree, assist your future exertions in the cause of science. "I am, &c.

"*Charles Babbage, Esq.* "HENRY GOULBURN.

"P.S. Sir R. Peel begs me to add, that as I have undertaken to express to you our joint opinion on this matter, he trusts you will excuse his not separately replying to the letter, which you addressed to him on the subject a short time since."

To this letter Mr. Babbage replied as follows:—

"MY DEAR SIR, *Dorset Street, Nov. 6, 1842.*

"I BEG to acknowledge the receipt of your letter of the 3rd of Nov., containing your own and Sir Robert Peel's decision respecting the Engine for calculating and printing mathematical tables by means of Differences, the construction of which has been suspended about eight years.

"You inform me that both regret the necessity of abandoning the completion of the Engine, but that not feeling justified in incurring the large expense which it may probably require, you have no other alternative.

"You also offer, on the part of Government, to withdraw all claim in the Machine as at present constructed, and to place it at my entire disposal, with the view of assisting my future exertions in the cause of science.

"The drawings and the parts of the Machine already executed are, as you are aware, the absolute property of Government, and I have no claim whatever to them.

"Whilst I thank you for the feeling which that offer manifests, I must, under all the circumstances, decline accepting it.

"I am, &c.

"C. BABBAGE."

Mr. Babbage had an interview with Sir R. Peel subsequently to the date of the foregoing letter: the result was, however, entirely unsatisfactory; and thus, with the communication from the then Chancellor of the Exchequer, terminated an engagement which had existed upwards of twenty years, during which period it is due to Mr. Babbage to state, that he refused more than one highly desirable and profitable situation²¹, in order that he might give his whole time and thoughts to the fulfilment of the contract, which he considered himself to have entered into with the Government.

With respect to the Difference-Engine little remains to be added. In 1843, an application was made to Government, by the Trustees of King's College, London, to allow the Engine, as it existed, to be removed to the museum of that institution. The request was complied with; and the Engine, enclosed within a glass case, now stands nearly in the center of the Museum. It is capable of calculating to five figures, and two orders of differences, and performs the work with absolute precision; but no portion whatever of printing machinery, which was one of the great objects in the construction of the Engine, exists. All the drawings of the machinery and other contrivances are also in King's College.

²¹ Mr. Babbage has shown me letters by which it appears that he declined offices of great emolument, the acceptance of which would have interfered with his labours upon the Difference-Engine.

Before closing this Chapter, it will not be out of place to put upon record the state of the Analytical-Engine at this period (1848).

Mechanical Notations have been made, both of the actions of detached parts, and of the general action of the whole, which cover about four or five hundred large folio sheets of paper.

The original rough sketches are contained in about five volumes. There are upwards of one hundred large drawings. No part of the construction of the Analytical-Engine has yet been commenced. A long series of experiments have, however, been made upon the art of shaping metals; and the tools to be employed for that purpose have been discussed, and many drawings of them prepared. The great object of these inquiries and experiments is, on the one hand, by simplifying the construction as much as possible, and on the other, by contriving new and cheaper means of execution, ultimately to reduce the expense within those limits which a private individual may command.